



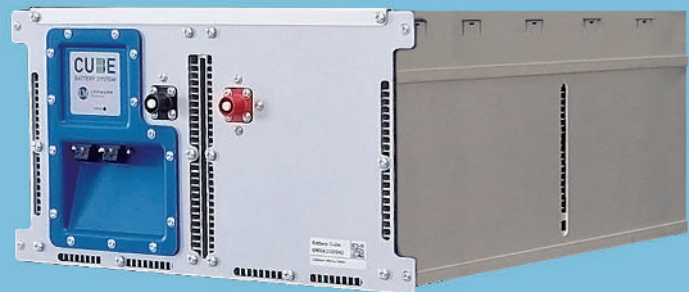
LEHMANN
MARINE

CUBE
BATTERY SYSTEM



CUBE FEATURES

- BV, DNV, LR & RINA Type Approvals
- Superior energy density
- Compact and lightweight
- Flexible and easy installation
- Innovative air-cooling
- Inherently safe LFP battery technology
- Cobalt- and nickel-free
- Scalable and modular design
- Integrated BMS and Pre-Charge



BUREAU
VERITAS



LFP BATTERY SYSTEM

Marine batteries as energy storage and power supply for propulsion significantly reduce fuel consumption, maintenance costs and emissions. With improved capacity-to-weight ratio from lithium-ion technology and growing demand for lower emissions, batteries have become an ever-increasingly attractive option for the large-scale supply of energy in the maritime sector.

CUBE is an advanced battery system employing inherent safe and environmentally friendly lithium iron phosphate cell technology and taking the special requirements of maritime operation and classification into account.

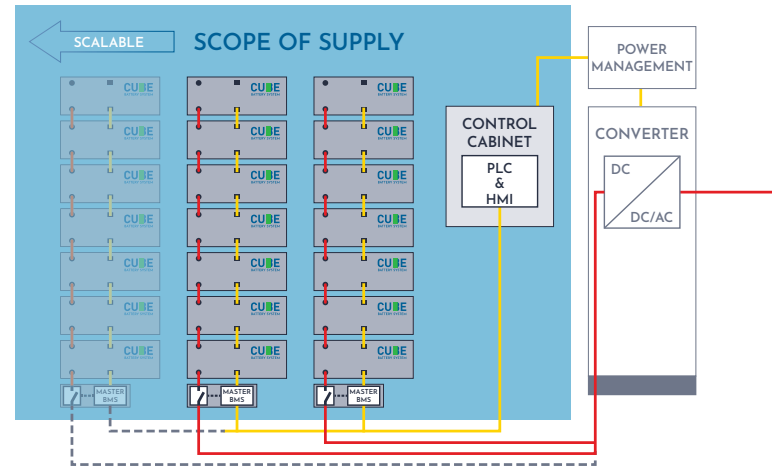
Any scale of power storage is available by freely configuring modular units in strings of up to 1,000 VDC. They include integrated Battery Management System (BMS), gas exhaust, pre-charge functionality and a sophisticated air cooling technology for safe and reliable operation.

The Battery CUBES are being assembled and tested in Lehmann Marine's production facility near the city of Hamburg.

CUBE PROPERTIES

- Flexible stacking for maximum utilization of the battery room
- 1 to 11 Battery CUBES per Battery String
- Up to 137,5 kWh and 1,000 VDC per Battery String
- Battery Cluster with up to 16 Battery Strings and 2.2 MWh
- Innovative air-cooling technology ensures uniform cooling of all cells for highest cycle life
- No propagation in case of thermal runaway on cell level and fulfilling of highest safety requirements
- Environmentally friendly LFP battery without cobalt and nickel
- Flexible Interface to Power Management System (CanBus, ModBus or others)
- Including Pre-Charge functionality

CUBE provides a modular battery design with superior energy density. A Battery Cluster with up to 16 Battery Racks and 1 Control Cabinet provides a capacity of 2.2 MWh. The CUBE system is scalable from a few kWh to



several MWh and allows for optimal use of battery room space. LFP battery cells and a permanent monitoring by Battery Management System on cell, module and on string level guarantees the highest standards for safety. LFP battery chemistry does not catch fire during thermal runaway, short-circuit or mechanical damage which makes the CUBE system a high-quality solution for the use at sea where safety is essential.



Picture © FSV Group

APPLICATION

- Electric drives
- Hybrid drives
- Peak shaving
- Hotel load
- Load leveling
- Energy storage

TECHNICAL DATA

Battery CUBE

Max. Voltage: 87 VDC
Min. Voltage: 60 VDC
Energy: 12.5 kWh
Energy density: 211 Wh/l & 7.68 kg/kWh



Exemplary Battery String (9 CUBES)

Energy: 112.5 kWh
Max. Voltage: 788 VDC
Min. Voltage: 540 VDC
Cooling: Forced air
C-Rate cont.*: 1 C
C-Rate RMS**: 0.6 C
Type Approvals: BV, DNV, LR, RINA

The CUBE system pictured to the right has a total energy capacity of 1,012 kWh (both sides of the isle) as an example.



* Cont.: complete charge or discharge
** RMS: Indefinite alternating charge or discharge

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